SURFACE WATER MONITORING

Masanori Ando
Musashino University, Japan

Keywords: surface water, monitoring, sampling, monitoring program, monitoring location, sampling programs, flow measurement, sampling techniques, sampling equipment, transport and storage, record

Contents

Summary

Surface water lie on the earth's surface and may occur either naturally as streams, and river, lakes, and ponds, or as human-made lagoons or other surface impoundments. This publication provides a comprehensive source of information on procedures for monitoring surface water quality. This chapter gives guidance on the classification of program for monitoring, establishment of sampling locations, design of sampling program, flow measurements, sampling techniques and equipment and the collection of samples when monitoring surface water.

1. Introduction

Surface water lie on the earth's surface and may occur either naturally as streams, and river, lakes, and ponds, or as human-made lagoons or other surface impoundments. Design of program for sampling surface waters are used not only for aqueous, or water-based, environments but also for nonaqueous environments, such as lagoons and surface impoundments intended for the storage of chemical waste. Understanding of the purposes for monitoring surface water and of the principles behind the methods of analysis is important, since specific sampling protocols can vary widely in accordance with different purposes and different analytical methods. This publication provides a comprehensive source of information on procedures for monitoring surface water quality.

2. Outline of Surface Water

The term hydrologic cycle refers to a series of processes involving the constant movement of atmospheric water, surface water and groundwater above, on, and below the Earth's surface. The water may also enter streams, lakes, or oceans from below the land surface. Water that reaches streams or other surface water bodies, both by overland flow and by groundwater discharge, moves to larger streams and rivers, and then to the lakes or oceans, where it is evaporated in a continuation of the hydrologic cycle. Approximately 2~3% of the earth's water exists in land as freshwater. 99% of world freshwater exists in the form of ice and groundwater, and the rest only accounts for less than 1% of the world fresh water is surface water such as river and lake water.

3. Monitoring Program for Surface Water

3.1. Objectives of Program for Surface Water Monitoring

This section is intended to provide an effective tool for maintaining high quality waters and improving the quality of waters that do not attain water quality standards. Effective monitoring of surface water requires collaboration between sampling program designers and interested party on controlling of surface water. This section also provides water resource managers and citizens with detailed information. In some situations it becomes necessary to define programs for the monitoring of surface water subject to risk of contamination. Surface water sampling can be carried out as a single exercise as part of a larger site or environmental investigation or as part of a regional/national program. Regardless of the purpose, a rational approach should be taken that clearly defines the objectives and strategies, determines the level of information needed and identifies the various stages of the investigation.

3.2. Classification of Program for Surface Water Monitoring

3.2.1. General

These procedures on surface water quality monitoring should be fundamentally used and produced by each organization. This chapter sets out the general principles for, and provides procedure on, the design of sampling programs and sampling techniques for all aspects of sampling of water (including waste waters, sludge, effluents and bottom deposits). The surface water quality monitoring programs provide for an integrated evaluation of physical, chemical, and biological characteristics of aquatic systems in relation to human health concerns, ecological conditions, and designated uses.

3.2.2. Routine Monitoring Network

Water controlling bodies are normally required to provide the information monitored to define water quality and to respond to perceived risk for pollution where selecting sites for routine ambient fixed-station monitoring. The routine monitoring network includes the collection of physicochemical biological and hydrological data at carrying frequencies from the stream, reservoir, and estuary segments across.

3.2.3. Intensive Surveys

Intensive surveys are short-term studies where specific hydraulic and water quality measurements (primarily dissolved oxygen) are made under low-flow conditions over several days. These are used to evaluate wastelands, verify stream standards, address existing or potential special water quality problems, and document water quality after controls are implemented.

3.2.4. Special Studies

Special studies provide to the each organization with an improved understanding of sources, distribution, and fate of particular constituents in selected reaches of water bodies. Special study monitoring is used to assess toxicity in surface waters and impacts of point and nonpoint source discharges; and to develop water quality controls and assess improvements after enforcement actions or implementation of controls.

3.2.5. Industrial Water and Affected Fields Studies

In terms of the industrial system, it can be said that the field of application in monitoring of water quality in area is defined by the demands imposed the law at the point of discharge (monitoring of output). The measuring aims in the activities indicated above are, from an industrial point of view, first and foremost observance of the law and compliance with requests from controlling authorities (monitoring of output). The economic necessity to optimize the management of waters forms a second aim (monitoring of input, monitoring of intermediate waste water). The need for environmental control, often imposed on industry by health authorities, constitutes a commitment which requires the development of monitoring activities that accompany remediation activities in cases where the environmental situation is endangered (monitoring of groundwater, monitoring of contaminated sites, monitoring of sediments)

4. Establishment of General Monitoring Location

4.1. Selecting a Monitoring Site

It is important to consider monitoring sites that will best characterize water quality, especially when selecting sites for routine ambient fixed-station monitoring.

4.1.1. Site Access

Select sites where sampling can be conducted safely during most expected flow conditions.

4.1.2. Historical Sites

Consider historical water quality data is very useful in assessing use attainment, impairment, and the analysis of trends. Consider continued sample collection at sites that are on current or past monitoring schedules.

4.1.3. Designated Uses

Typical designated uses include public water supply, aquatic life, contact recreation, or human health. Bacteriological samples should be collected at all routine monitoring sites and under all flow conditions. The contact recreation use currently applies to all surface waters and not only swimming areas.

4.1.4. Locating Representative Sites

Select monitoring sites that best represent water quality conditions of an entire water body. A water body with significantly different water quality (contaminant sources or water quality problems) may require additional sites.

4.1.4.1. Mixing Zones

A mixing zone is defined as the area adjacent to a wastewater discharge point where mixing with the receiving water occurs. In selecting a monitoring site, keep in mind that location below effluent discharges may not accurately represent water quality conditions of that water body and must be located outside the mixing zone.

4.1.4.2. Monitoring Below Dams

Water quality conditions created by a dam release are generally not characteristic of a water body. Monitoring sites should be located far enough downstream to be out of any area influenced by a dam release. Also keep in mind the type of dam release (top or bottom). Water released from the bottom (hypolimnion) of a reservoir will have lower dissolved oxygen (DO) levels than water released from the top (epilimnion).

4.1.5. Representative Monitoring Site

Water quality data should be setup a lot of stations more than one station for segments with very different water quality or pollution potential. This allows representative data to be collected for all parts of the segment. This is true even for small segments.

4.2. Identifying the Sampling Location

Depending on the objectives to be achieved (see Section 5.2), the sampling network can be anything from a single site to, for example, an entire river catchment. A basic river network can comprise sampling sites at the tidal limit, major tributaries at its confluence and major discharges of sewage or industrial effluent. In designing water quality sampling networks, it is usual to make provision for the measurement of flow at key stations.

4.3. Industrial Water Monitoring Site and Considered Concepts

The industrial measurement needs illustrated above necessitate the development of diverse instrumentation. As far as the first need is concerned i.e. waste control (monitoring of output), the ranges to be measured are substantially those comprised within the water quality standard lists in each countries. The legal control of waters requires considerable reliability from the instrumentation utilized in continuous monitoring. The discharge of cooling water from industrial plants such as thermo-electric power stations can create ecological problems. Monitoring of water and ecological conditions must be studied with care and assessed for environmental impact. Briefly, it can be said that it is fundamental to develop instrumentation able to monitor the result of the principal depuration treatment processes utilized in industry.

-
-
-

Bibliography

Colin F. and Quevauviller P.,(1998) Monitoring of water quality [This report describes the Proceedings of the European workshop on standards, measurements and testing for the monitoring of water quality]

International Standard ISO5667-1 Water quality-Sampling- Part 1: Guidance on the design of sampling programs and sampling techniques 2006 [This report describes the guidance on the design of sampling programs and sampling techniques]

International Standard ISO5667-3 Water quality-Sampling- Part 3: Guidance on the preservation and handling of water samples 2003 [This report describes the guidance on the preservation and handling of water samples]

International Standard ISO5667-4 Water quality –Sampling- Part 4: Guidance on sampling from lake, natural and man-made 1987 [This report describes the guidance on sampling from lake, natural and man-made]

International Standard ISO5667-5 Water quality-Sampling- Part 5: Guidance on sampling of drinking water from treatment works and piped distribution systems 2006 [This report describes guidance on sampling of drinking water from treatment works and piped distribution systems]

International Standard ISO5667-6 Water quality-Sampling- Part 6: Guidance on sampling of rivers and streams 2005 [This report describes guidance on sampling of rivers and streams]

International Standard ISO5667-14 Water quality-Sampling- Part 14: Guidance on quality assurance of environmental water sampling and handling 1998 [This report describes guidance including sampling quality control techniques, transport, storage of samples]

International Standard ISO15553 Water quality-Isolation and identification of Cryptosporidium oosysts and Giardia cysts from water 2006 [This report describes isolation and identification of Cryptosporidium oosysts and Giardia cysts from water]

International Standard ISO9308-2 Water quality-detection and enumeration of coliform organisms, thermotolerant coliform organisms and presumptive *Escherichia coli*- Part 2: Multiple tube (most probable number) method 1990 [This report describes detection and enumeration of coliform organisms, thermotolerant coliform organisms and presumptive]

Biographical Sketch

Masanori Ando is with the Faculty of Pharmaceutical Sciences of Musashino University as professor, where he has been in his present post since 2004. He obtained a Bachelor Degree in Meiji Pharmaceutical College in 1970. He worked for National Institute of Health Sciences until 2004. In the meantime, he obtained a Ph.D in Pharmaceutical Sciences from Tokyo University. He has written and edited books on risk assessment, management and analytical standard methods of drinking water, indoor air chemicals, air toxicants and cosmetic strategy. He has been the author or co-author of approximately 120 research articles. He is member of Japan Society on Water Environment, Pharmaceutical Society of Japan, Japan Society for Environmental Chemistry, Japan Society of Endocrine Disrupters Research, Japan Water Works Association, Society of Indoor Environment Japan, The Japanese Society of Toxicology.